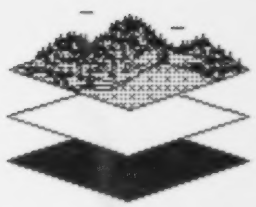

A Component of British Columbia's Land Use Strategy

North Coast LRMP

Background Report

Aquatic and Riparian Habitat and Values in the North Coast

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October 2003

BRITISH COLUMBIA

Executive Summary

Management to maintain hydroriparian ecosystem health requires an understanding of inherent values, and resource management issues. This report provides background on aquatic and riparian resource values within the North Coast LRMP area. It also deals with management challenges associated with fish, wildlife and biodiversity arising from development related impacts (primarily roads and forest harvesting) upon hydroriparian ecosystems. In keeping with the general principals of ecosystem-based management, mitigation of risk can be achieved through the use of scientific research, inventory, monitoring and adaptive management that collectively aim to keep human induced change (ecosystem risk) to a minimum.

Detailed discussions regarding hydroriparian management are summarized under 3 broad subject areas:

- **Maintaining natural levels of water quality and rates of flow:** Matters highlighted concern naturally unstable areas, windthrow, development approach and biological monitoring of change to aquatic ecosystems.
- **Maintaining the productive capacity of important and critical fish and wildlife habitat:** Topics included are important and critical fish and wildlife habitats, freshwater and near-shore marine aquatic habitats, high-value wildlife trees, hydroriparian corridors, tailed frog habitat, bald eagle, osprey and heron nesting territories, coarse woody debris and non-fish streams.
- **Maintaining biodiversity hotspots within hydroriparian ecosystems:** Areas of special or concentrated biodiversity value that are discussed include floodplains, alluvial fans, lakes, wetlands, estuaries, swamp forests, sloped blanket bogs, limestone, karst, geothermal hotsprings and key hydroriparian areas of concern: the Skeena/Ecstall riparian corridor, and Khtada and Union lakes.

Acknowledgements

Thank you to the individuals who contributed their time and knowledge to this document, including Dave Gordon (R.P.Bio.), Hannah Horn (BSc, MRM), Denise Van Raalte (BSc) and the other members of the North Coast LRMP Government Technical Team.

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1 Introduction

This report provides background information on aquatic and riparian resource values within the North Coast LRMP area. It deals with management issues associated with fish, wildlife and biodiversity arising from development related impacts (primarily roads and forest harvesting) upon hydroriparian ecosystems In keeping with the general principals of ecosystem-based management, mitigation of risk can be achieved through the use of scientific research, inventory, monitoring and adaptive management that collectively aim to keep human induced change (ecosystem risk) to a minimum. Opportunities are outlined.

1.1 Resource Values

The North Coast LRMP plan area includes an array of aquatic and riparian communities that in combination render an extraordinary number of microhabitats for a vast number of species. In particular, higher order, and larger low gradient stream systems support an impressive number of life forms. Great structural diversity and a diverse mix of oftentimes-rich productive habitat likewise characterize these same places.

Because of tremendous overlapping value, when managing human activity, it is fundamentally important to deliberately consider fish and wildlife use, the interdependence of aquatic and riparian habitats, and the influence of adjacent upland habitats.

Hydroriparian ecosystems of concern include streams, rivers, lakes, wetlands, marine and adjacent riparian habitats. These areas are to varying degrees important to all fauna. The North Coast supports an estimated 38 fish, 6 amphibians, 1 reptile, 248 birds, and 62 mammals (rodents, bats, small carnivores to large mammals excluding whales and dolphins.)[1]

Approximately 29% of wildlife species found in riparian forests in the Pacific coastal ecoregion are species that depend upon riparian and aquatic resources to the extent that they will experience severe population reductions if riparian forests are lost.[2]

All freshwater fish are dependent upon healthy aquatic and riparian ecosystems. Steelhead and Pacific salmon (pink, chum, coho, chinook, and sockeye) in particular provide vital economic opportunities for North Coast communities and are ecologically important species in both freshwater and marine ecosystems. The plan area supports over 500 known salmon stocks, a number of which are presently in

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[1] Liepins, S. 2002. *NCLRMP vertebrate species list by life form.* Draft 1: 15 April 2002. Also see: Gordon, D. and M. Bahr. 2003. *Freshwater and Anadromous Fish and Fish habitat in the North Coast.* NCLRMP Background Report.

2 Kelsey, KA and SD West. 1998. Riparian Wildlife. In River Ecology and Management: Lessons from the Pacific Coastal Ecoregion (R.J. Naiman and R.E. Bilby eds). Springer Verlag. New York.

decline. Factors attributed to observed declines include but are not limited to hydroriparian habitat degradation.[3]

Invertebrate diversity includes insects, spiders, mites, worms, clams, crabs, anemones, and starfish to mention only a few of the more readily visible groups. Many, such as canopy arthropods and benthic invertebrates hold true to very specialized habitat requirements and thus can be rather vulnerable to relatively minor shifts in ecosystem condition. Invertebrates (animals without backbones) are responsible for many critical ecosystem functions like nutrient cycling. Though frequently overlooked, their sheer biomass forms a major component of the greater and very complex coastal food web. Invertebrate populations in turn depend upon healthy ecosystems.

Many riparian communities are of management concern due to their vulnerability to development. These include red- or blue-listed riparian ecosystems[4] (i.e. floodplain forests), karst landforms, and additional "at risk" ecosystems as identified in an environmental risk assessment of biodiversity for the plan area[5]. Biodiversity includes vascular plants, mosses and liverworts, lichens, alga and fungi (including unseen mycorrhizal fungi, soil biota which directly enhance tree growth and forest productivity). Productive riparian sites grow large trees that contribute significantly to structural diversity of habitats and are thus integral to hydroriparian ecosystem functioning.

Clearly a number of life forms, from microbes and invertebrates to vertebrates (animals with backbones), are obligate hydroriparian species and unable to successfully conduct the business of life elsewhere. Other species frequent hydroriparian areas more by choice. While it is correct that some do not absolutely require either riparian or aquatic areas, these places often remain as preferred or optimum habitats.

The health of aquatic and riparian ecosystems is dependent on a full suite of intact ecological functions that in concert foster life in a self-sustaining manner. These functions include but are not limited to:

- transporting water;
- providing and transporting downed wood, and other organic material;
- filtering and transporting sediment and dissolved materials;
- moderating microclimate, i.e. shading streams and raising ambient humidity;
- stabilizing banks;
- providing corridors for animal movement and plant dispersal;
- providing breeding, rearing and feeding habitat for aquatic and terrestrial animals; and
- providing biodiverse habitat arrangements unique to hydroriparian ecosystems.

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[3] Gordon, D. and M. Bahr. 2003. *Freshwater and Anadromous Fish and Fish habitat in the North Coast.* NCLRMP Background Report.

[4] BC Conservation Data Centre

[5] Holt, Rachel F. and Glenn Sutherland. 2003. *Coarse Filter Biodiversity. Environmental Risk Assessment: Base Case.* NCLRMP document.

1.2 Resource Issues

Current management of hydroriparian ecosystems is primarily focused upon the protection of water, fish and fish habitat. Traditionally far less emphasis has been placed upon wildlife and biodiversity, which to some extent have been managed by default. Development can correlate with high risk when important values occur but are not specifically accounted for. As a general principal of ecosystem-based management, it is essential that deliberate decisions be made with regards to how all key resources are managed. This is all the more imperative when high values overlap (as is the case for hydroriparian ecosystems) and the extent of human activity may be such that the naturally occurring condition of an ecosystem is significantly altered.

Life as we know it depends upon the health of ecosystems. The potential of degrading the quality of life (ecosystem health) increases as ecosystems are increasingly modified or simplified by human activity. Thus conventional wisdom leads us to a precautionary approach and the notion of moderating degree of change as a form of reducing risk. Realistically however resource managers operate within the realm of detectable rates of change and detectable impacts and trust that to do so is good enough. Yet there must also be an acknowledgement that considerable human induced change may well go unnoticed. Some level of risk will forever accompany development of hydroriparian ecosystems.

Reduced ecological functioning is a risk when development results in change. There is direct change, such as when an old growth forest is cut and becomes a young forest. And indirect change as experienced when residual habitats are converted from interior to edge condition or otherwise essentially influenced. Whether developments occur within aquatic or riparian ecosystems or alternatively on slopes above, developments in coastal areas with high rainfall and unstable terrain have the potential to harmfully impact hydroriparian areas. Development may exacerbate windthrow[6], mass wasting and sedimentation from upland areas, into streams and streamside forests. Disturbances of marine blue clays and other easily mobilized sedimentary deposits are of particular concern.

Riparian habitats of greatest importance and primary concern are those of lower gradient and noteworthy complexity. Due to the mountainous topography of the North Coast, these are spatially limited, typically occurring in close association with mainstem reaches, and at low elevations in valley bottoms. Similarly these are usually preferred locations for resource development activities, with roads and railways limited by operational and logistical constraints. Timber harvesting, and residential and industrial developments also tend to occur in valley bottoms.

Paradoxically the interconnections of life, land and water yield both a strength and a vulnerability to ecosystems. An ecosystem, responding to large-scale change can be both resilient and fragile. Resilient, as there may be many different elements, with somewhat different needs and life strategies, contributing to and mutually supporting the various ecosystem functions. Fragile, because the decline of a few key elements (keystone species) past some unforeseeable threshold might trigger a domino effect with disturbing and perhaps irreversible impacts.

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[6] The entire North Coast Plan area is considered a windthrow prone zone. (pers. comm. Dan Motisca, MoF) Although impractical to mitigate catastrophic wind events, mitigation of endemic windthrow is possible. Also see *Windthrow handbook for British Columbia Forests*. 1994. MoF Research Program Working Paper 9401.

The degree to which managers maintain the natural condition of hydroriparian ecosystems (with their full complement of parts) will greatly influence future ecological status and the overall productivity of the entire landbase.

1.2.1 A practical definition of aquatic and riparian ecosystems (hydroriparian ecosystems)

Conceptually, hydroriparian ecosystems are aquatic ecosystems plus adjacent terrestrial ecosystems that are influenced by, or influence, the aquatic system. They extend vertically, below ground in the soil, and above ground into the vegetation canopy.[7]

Defining hydroriparian ecosystems can however be difficult in practice. Interpretations of zones of influence will vary depending upon site specifics and the range of ecosystem functions under management consideration. A singular goal of maintaining stream structure on a coarse woody debris dependent stream would likely be satisfied by retaining all sizeable trees within one tree height distance. In contrast, management goals to address forage supply needs of obligate riparian wildlife (i.e. adult tailed frogs) may have to extend 200-300 metres or more from the waterline to yield a similar success.

For the purposes of this document hydroriparian ecosystems are defined by the area of aquatic habitat and adjacent riparian plant communities obviously influenced by water (i.e. low to high-bench floodplains, wetland forested fringes, swamp forests and salt-spray shoreline forests), plus the area extending one and a half tree heights[8] (horizontal distance) beyond.

Exceptions:

- For aquatic systems without an obviously distinct riparian plant community[9], the hydroriparian ecosystem is considered to extend one and a half tree heights[8] from the waterline. This is a horizontal distance as measured from the high water mark.

- For the purposes of marine, large lake and large river shorelines, the hydroriparian ecosystem extends a minimum 200m from the waterline. This interpretation is invoked in accordance with science-based information regarding the distribution of nesting territories for species of conservation concern (i.e. the bald eagle).

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[7] Hydroriparian planning guide. Coast Information team.

[8] Site-specific tree height as derived from the tallest trees present, however if the stand is not mature then an approximation derived from the site capability (forest cover inventory) should be used.

[9] I.e. A small headwater stream may be associated with shoreline (riparian) vegetation that appears similar to the broader surrounding upland plant community.

2 Ecosystem-based Management Practices

Management guidelines outlined below assume minimizing human induced change as the primary method of maintaining a low risk to ecosystem health. A risk adverse precautionary approach is suggested for hydroriparian ecosystems where site specific and/or watershed level information is lacking. Management opportunity and flexibility can be gained as information specific to hydroriparian values is acquired by means of assessment and inventory. This approach is consistent with the principals of ecosystem-based management.

Discussions regarding hydroriparian management are summarized under 3 broad subject areas:

- Maintaining natural levels of water quality and rates of flow
- Maintaining the productive capacity of important and critical fish and wildlife habitat
- Maintaining biodiversity hotspots within hydroriparian ecosystems

Note however that hydroriparian ecosystems are highly integrated and the subdivisions as structured above are not entirely exclusive. Categories provided are organizational constructs to aid orientation and deliberations. Regardless of how one teases apart the complicated relationships of hydroriparian spaces, a holistic approach will be necessary to ensure that complete biological functionality continues unimpaired.

2.1 Maintaining natural levels of water quality and rates of flow

Water is a dynamic functioning part of nature and though as a whole it is abundant, usable fresh water is not. Most water is tied up in the oceans, clouds, and icecaps with only 0.77% of the total amount of water on the planet being fresh and freely circulating about.[10]

Water quality in Canada is generally considered good although "boil water advisories" related to contamination are becoming more common across the nation. On a global scale however the quality of fresh water has been deteriorating more rapidly with water in many places no longer deemed safe for human consumption. A shortage of clean fresh water may well become the primary limiting growth factor to human populations.[11]

In recognition of the high value British Colombians place upon drinking water, domestic water supply areas have formally been designated as "community watersheds". Five community watersheds exist within the LRMP area. Although development within these watersheds is permissible, more stringent regulations apply and to date little development has occurred.

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[10] Martinec, J. 1985. *Time in hydrology.* in *Facets of hydrology II.* Ed. J.C. Rodda 249-290. New York: John Wiley & Sons.

[11] Pielou, E.C.1998. *Fresh Water.* The University of Chicago Press.

Table 1. Community watersheds within the North Coast LRMP area.

Community Watershed	Creek	Size (ha)	Comments
Dodge	Dodge Creek	14	On Digby Island
Gabion	Gabion River	1881	Hartley Bay
Shawatlan	Shawatlan River	2488	NE of Prince Rupert
Stumaun	Stumaun Creek	856	SE of Port Simpson
Wolf	Wolf Creek	1465	Port Edward

In the North Coast, with over 250 cm of mean annular precipitation, water shortage does not tend to preoccupy people's thoughts. Water quality and how it flows however is another matter. The importance of water quality and flow extends far beyond immediate human interests. It is vital to salmon and all other fresh water fish, wildlife, biodiversity and ecosystem health.

Thus there are numerous laws, regulations, and policies currently in place to safeguard water resources across the broad landbase. Specific development activities (i.e. road building, forestry, water diversion or export) that are likely to cause changes to water quality or rates of flow or may harmfully affect fish habitat are subject to review by Fisheries and Oceans Canada (and possibly other federal and provincial agencies), as well as a Canadian Environmental Assessment Agency (CEAA) screening or review.

In principal, water quality should be reasonably maintained if existing legislation, and policy are adhered to however some uncertainty remains. Development has a potential to change hydrological response both at peak flows and low flows, and can reduce base flow response. Development can also result in excessive sedimentation of aquatic systems. Additional measures could be taken:

1. to reduce development related erosion and mass failures in naturally unstable areas,
2. to ensure that erosion due to windthrow is not exacerbated by development,
3. to reduce the risk of stream sedimentation related to development approach,
4. and to implement biological monitoring of change to aquatic ecosystems.

2.1.1 Naturally Unstable Areas (sedimentary deposits and terrain classes IV, V)

Ground disturbance, altered drainage patterns, or removal of trees are some of the factors that can promote mass wasting. In areas with inherently unstable terrain the risk of failure related to development is on the high end.

As with terrain classes IV and V (naturally unstable areas), development in areas with easily mobilized sediment deposits may contribute excessive silt, sand or marine clays to aquatic habitats. These

materials can affect water quality and settle out in low velocity areas in streams, potentially smothering incubating eggs, alevins, hatchling tadpoles and invertebrates. Disturbance also has the potential to alter the physical structure of aquatic habitats. Habitat can be affected for many kilometres downstream. Such disturbances can be impractical to remediate after the fact.

At this time required geotechnical assessments fail to consistently detect marine blue clay deposits (expected to occur at elevations of <=300m) and other easily mobilized sedimentary deposits. Reliable detection could better facilitate the development and implementation of appropriate strategies to deal with hazards. Greater certainty could be achieved by

- making the detection of easily mobilized sedimentary deposits a primary goal of assessments
- broadening the scope of assessments to the field of geoscience and by
- ensuring that experts conducting terrain stability assessments have knowledge and experience in quaternary science

Traditionally decisions regarding whether to develop (i.e. road build, harvest) unstable areas are made in a risk management context that considers both the likelihood and consequence of failure. An assessment of "consequence of failure" is typically based upon best available information that may be limited and fail to recognize some key values (i.e. tailed frog breeding and rearing habitat). Thus human induced impacts might be further reduced by:

- Stepped-up requirements to comprehensively assess a broader range of potential downslope and downstream values (i.e. tailed frog habitat, fish habitat). Judgements regarding consequence of failure should be fully informed.
- Ongoing monitoring (i.e. Benthic Invertebrate Assessment Monitoring) of aquatic habitats where development activities occur in areas with natural instability. Signals that water quality or riparian condition is deteriorating could initiate corrective adjustments in management direction.
- Timing operations that might result in sedimentation of aquatic habitat to coincide with periods of lowest risk to fish and resident tailed frogs. Periods of highest risk typically correlate with times when animal mobility is reduced such as when eggs, alevins and hatchling tadpoles are in the system.

Note: Landslides which result in the deposit of organic materials including whole trees into aquatic systems down slope are naturally occurring and important disturbance events which help to maintain stream structure and function and habitat diversity. Mass failures are considered beneficial to ecosystems providing they occur at natural rates. Harvesting of naturally unstable terrain removes trees from the site and thus can substantially reduce future coarse woody debris inputs to aquatic ecosystems from that portion of the landbase that is harvested. See the section below on Coarse Woody Debris for more information.

2.1.2 Windthrow

Windthrow is a significant agent of change in coastal ecosystems. The entire North Coast Plan area is considered a windthrow prone zone. Although impractical to mitigate catastrophic wind events, mitigation of endemic windthrow in development settings is possible.[12] Forest management objectives designed to moderate ecosystem change should include the prevention of development related blowdown. Of particular concern are harvest patterns that result in narrow exposed strips of riparian forests that become, by a flaw of design, more prone to windthrow. Riparian forest that blows down can cause considerable disruption (i.e. erosion, sedimentation and blockage) in aquatic ecosystems and change riparian condition to the degree that trees are broken or blown over. Development should not increase windthrow vulnerability of forest stands.

The North Coast Forest District, Ministry of Forests[13] is recommending that harvesting and road building plans be preceded by "watershed level windthrow potential mapping" to ensure that vulnerable areas will be identified up front and mitigation of risk will occur.

2.1.3 Development approach: Dual developments

Any development which simultaneously modifies both sides of a stream (dual development) increases the risk of ecosystem change. Excessive sediment introductions from either improperly maintained or deactivated roads into streams can result in reduction of water quality and degradation of habitat. Risk is correlated to the amount of road surface and to a lesser extent, the amount of harvested area. In addition, options for undisturbed wildlife use are more limited where harvesting or road access occurs on both sides of a valley bottom. Dual developments should be avoided where possible. Alternatively, where dual development is undertaken, enhanced streamside buffers that have forest interior attributes might achieve risk mitigation. The Biodiversity Guidebook recommends targeting 600m as a minimum width when providing forest interior as a management objective.[14]

2.1.4 Biological monitoring

Biological monitoring (biomonitoring) of aquatic life is a useful tool to detect development related change to water quality thus enabling management corrections in a timely manner.

Changes in chemical, physical and morphological components of a stream may alter stream quality. The interactions of factors affecting streams are complex and often cumulative. Biomonitoring permits an ongoing appraisal of change to overall stream quality. Interpretation of collected data is a first step in designing management plans but also allows early detection of impact and development of mitigation strategies for environmental degradation. In the Skeena Region, work developing the "benthic invertebrate index of biological integrity" (B-IBI) began in 1999. It is one monitoring tool available for use in assessing road building and forest harvesting impacts. The protocol for the development and use

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[12] (pers. comm. Dan Motisca, MoF) also see *Windthrow handbook for British Columbia Forests*. 1994. MoF Research Program Working Paper 9401.

[13] pers. comm. Dan Motisca

[14] forest interior condition as defined in the *Forest Practices Code of BC Biodiversity Guidebook. September 1995.* Page 79. "We recommend targeting 600m as a minimum width when providing forest interior as a management objective."

of an aquatic ecoregion specific multimetric approach to assessing stream condition is described in *Guidelines for Calibrating a Benthic Invertebrate Multimetric Index of Biological Integrity (B-IBI) for Streams in British Columbia"*[15]

Efforts to maintain water quality and flow are most effective when biological monitoring is preceded by geoscience work resulting in appropriate mitigation of risk at the outset.

2.2 Maintaining the productive capacity of fish and wildlife habitat

The structural integrity and functioning of aquatic and riparian habitats are to varying degrees protected by the existing regulations in the Forest Practices Code and by other acts and guidelines (*Fisheries Act, Land Development Guidelines*).

Current management however is largely driven by fish and fish habitat values. Furthermore there is no legislated requirement for comprehensive assessment of hydroriparian values (fish, wildlife, biodiversity) in advance of development. Although many benefits are derived from current practice few non-fish species are explicitly considered and thus some values are at greater risk than others. A greater commitment to inventory and assessment prior to development will better ensure that a larger set of values is adequately protected.

The following hydroriparian habitats/elements merit added consideration in developing resource management direction:

1. Important and critical fish habitats
    a) Freshwater
    b) Marine
2. Important and critical wildlife habitats
    a) High-value wildlife trees
    b) Hydroriparian corridors
    c) Tailed frog habitat
    d) Bald eagle, osprey and heron nesting territories
3. Coarse woody debris
4. Non-fish streams

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[15] Bennet, Shauna and Kieran Rysavy and Linda Currie. Bio Logic Consulting, Terrace, BC. Draft version 1.1, June 2003.

2.2.1 Important and critical fish habitats

Development activities can potentially degrade important fish habitat and/or interrupt fish productivity. Important habitats are considered critical if change has a potential to either diminish or eliminate a fish stock.

2.2.1.1 Freshwater Habitats

Freshwater habitats that significantly influence the abundance and survival of a particular stock or population of fish include the following areas of importance:

- productive spawning beds for salmon, trout, eulachon, or other fish,
- productive rearing habitat, overwintering habitat and high-water refuge areas.

At present forestry harvesting and road building activities are informed by detailed fish and fish habitat inventories if available. More typically however, developments are guided by a low-level fisheries assessment that roughly approximates fish presence or absence, requiring little more than a field assessment of stream attributes (width and gradient). If thought necessary, more detailed documentation of fish presence or absence and fish habitat value may specifically be collected to further inform development planning.

Mitigation strategies to ensure that harmful changes do not result from developments include the protection of important or critical habitats from impact and the timing of potentially harmful activities (i.e. in-stream works and cross stream yarding) to occur during periods of lowest risk.

Baseline information useful in the implementation of such a strategy would include watershed level[16] documentation of:

- the distribution and relative importance of important/critical fish habitats, and
- complete fish assemblages (to the level of species), which occur.

2.2.1.2 Marine Habitats

Our understanding of fisheries values of the marine riparian area is not as well developed as for freshwater ecosystems, nevertheless the sensitive habitats identified in the note below can be considered as important and potentially critical fish habitats.

Fisheries and Oceans Canada provides the following guidelines in regards to marine buffers[17]:

A. For Crown Land coastal marine habitats, provide intact riparian zones of:

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[16] Watersheds BC. In the event that a watershed is large with a number of disconnected creek systems, information needs might be reduced to the connected creek system from headwaters to outflow within a watershed

[17] pers. comm. Dale Gueret, Fisheries and Oceans Canada, Prince Rupert, BC.

1. MINIMUM of 100 m (from HHW) windfirm buffer along the full length of sensitive habitats, *plus* 50 m buffer length on either side of the boundaries of the sensitive habitat. (*Sensitive habitats include: estuaries, eel grass meadows, kelp beds, shellfish beds, herring spawning areas, smelt and sand lance spawning beaches, salt marshes, mudflats, rocky reef habitats supporting rockfish spawning or nurseries, salmon spawning beaches, juvenile salmonid nursery and rearing areas, and adult salmon holding areas*).

2. MINIMUM of 50 m (from HHW) windfirm buffer for all other Crown Land shorelines.

B. Minimum of 15m (from HHW) intact riparian zone in disturbed urban areas.
C. Minimum of 30m (from HHW) intact riparian zone in undisturbed urban areas.

D. Exceptions to allow for access and other specific developments :

- A reduced or nil buffer zone of up to 10% (100 m) of 1 km of lineal length of shoreline in the A(2) category can be allowed, subject to mitigation and/or compensation requirements for harmful alteration, disruption, or destruction of fish habitat.

- No further development within 1 km of shoreline on either side of an access point will be allowed until the function of the riparian zone of the existing 10% opening is restored.

- Riparian zones fronting sensitive habitats (including the buffer lengths on each side of the sensitive habitat features per A.1) normally will NOT be compromised for access, etc.

"Exception guidelines" to allow access etc. in urban areas have yet to be developed.

2.2.2 Important and critical wildlife habitats

In general hydroriparian ecosystems in their entirety are viewed as important wildlife habitats however some key attributes within this zone can be readily identified and so can be managed for on an individual basis.

Wildlife use both aquatic and riparian habitats for breeding, nesting, resting, food gathering, security cover and travel (daily and/or seasonal movements, and dispersal of young). Important and identifiable wildlife attributes include but are not limited to high-value wildlife trees, raptor nests, heronries, and areas of concentrated use as evidenced by wildlife sign including: den sites, loafing areas, defined large mammal game trails (particularly those confined by topography), bear mark trails and mark trees, bear fishing locations, ungulate winter range and mineral licks. Qualified professionals conducting surveys in advance of development can noticeably help ensure that identifiable values are recognized and appropriately protected.

Wildlife species of particular concern include blue- or red-listed species as well as yellow-listed "conservation species". Some examples are tailed frog, fisher, grizzly bear, American bittern, sandhill crane, various seabirds, and wildlife tree users (goshawk, bald eagle, great blue heron, osprey, marbled

murrelet, owls, bats and cavity nesting waterfowl). For a more comprehensive list consult the NCLRMP plan area species life forms list.[18]

Important habitats are considered critical if change has a potential to either seriously diminish or eliminate a sub-population of wildlife.

2.2.2.1 High-value wildlife trees

Wildlife trees are standing live or dead trees with special characteristics that attract wildlife. High-value wildlife trees[19] are habitat elements that are considered rare or declining. Retention of these elements will contribute to the conservation of species that utilize both wildlife trees and coarse woody debris, (fallen wildlife trees).

A high-value wildlife tree has at least two characteristics listed below:

- internal decay (heart rot or natural/excavated cavities present),
- crevices present (loose bark or cracks suitable for bats),
- large brooms present,
- active or recent wildlife use,
- current insect infestation,
- tree structure suitable for wildlife use (e.g., large nest, hunting perch, bear den, etc.),
- largest trees on site (height and/or diameter) and/or veterans,
- locally important wildlife tree species.

In this plan area:

Red-listed species that are wildlife tree users include marbled murrelet, Northern Goshawk (subspecies laingi) and Keen's long-eared myotis.

Blue-listed wildlife tree users include bald eagle, great blue heron, and fisher and coarse woody debris users include grizzly bear and tailed frog.

Yellow-listed conservation species that are wildlife tree users are pileated woodpecker, bufflehead, wood duck, barrow's goldeneye, common goldeneye, common merganser, hooded merganser, boreal owl, northern pygmy owl, northern saw-whet owl, western screech owl, osprey, weasel species, and pine

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[18] Liepins, S. 2002. *NCLRMP vertebrate species list by life form.* Draft 1: 15 April 2002. Also see: Gordon, D. and M. Bahr. 2003. *Freshwater and Anadromous Fish and Fish habitat in the North Coast.* NCLRMP Background Report.

[19] *Evaluation of Wildlife Tree Retention for cutblocks harvested between 1996-2001 under the Forest Practices Code.* For. BC. Min For. B.C. Min. Wat. Land Air Pro. Victoria, B.C. 2003.

marten.[20] Conservation species that are coarse woody debris dependent include northwestern salamander and spotted frog.

Improvement in the retention of high-value wildlife trees would contribute greatly to the conservation efforts directed at wildlife tree users. Although wildlife tree retention is a current management requirement under the Forest Practices Code, there is no legislated requirement to ensure that "high-value wildlife trees" as opposed to "wildlife trees" are retained. The recent publication *Evaluation of Wildlife Tree Retention for cutblocks harvested between 1996-2001 under the Forest Practices Code.* (For. BC. Min. For. B.C. Min. Wat. Land Air Pro. Victoria, B.C. 2003) concluded that although wildlife tree retention is being widely implemented across the Province of BC there is room for improvement in the quality of wildlife tree habitat being retained. Thirty-three percent of sampled cutblocks contained no high-value wildlife trees within areas reserved for wildlife tree retention.

Wildlife tree retention should, as a first priority, protect trees with valuable wildlife tree attributes. Where there are few such trees, wildlife tree retention should be located in areas most suitable for long-term valuable wildlife tree recruitment.

Alternative silviculture systems that enable the retention of windfirm groups of wildlife trees (emphasis on high-value) within the harvest setting have been shown to contribute more effectively to wildlife conservation than standard clearcut systems. Furthermore the establishment of safe no work zones[21] around high-value wildlife trees that may be considered danger trees (workplace hazards) will also serve conservation efforts. Currently an undetermined proportion of high-value trees in Forest Practices Code riparian reserve zones and management zones are downed as danger trees.

2.2.2.2 Hydroriparian corridors

Hydroriparian ecosystems frequently function as movement and dispersal corridors for wildlife allowing for ease of movement between dispersed resting, breeding and foraging sites across a broad landbase. Corridors also serve to link seasonal home ranges which otherwise may be discontinuous (i.e. summer range for an ungulate can be many kilometres distant from critical overwintering habitat).

Forestry developments (harvesting and road construction) can rapidly erode the wildlife value of a watershed by modifying movement corridors to the extent that function is degraded and important habitats are isolated. This is particularly true of developments that simultaneously and extensively modify both sides of mainstem streams and major tributaries (dual developments). Development planning approaches that include up-front management goals to maintain habitat connectivity and minimize habitat fragmentation are not conceptually new however implementation in the plan area has been rare and constrained by shifts in provincial policy. Much could be gained by a watershed level management focus that retains the structural and functional attributes of quality hydroriparian corridors.

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[20] as described in Backhouse, Frances. 1993. *Wildlife tree management in British Columbia.* Gov. of Canada, Prov. of BC and Machmer, M.M. and Steeger C.. 1995.

[21] *Riparian Management Area Guidebook.* 1995. FPC of BC. MoF and MELP pp40-41.

Proponents of development should ensure that natural movement corridors for wide-ranging mammals are identified prior to development and maintained in an unconfined manner. Wildlife movements should not be channelled onto a single narrow and predictable trail when multiple secure options are naturally available. Research has shown that predator-prey dynamics (i.e. coastal wolf and deer) can be thrown off balance by human induced change that increases prey vulnerability to attack.[22] Management objectives to buffer game trails will help ensure adequate visual screening and maintain the noise abatement qualities of security cover. Likewise natural control points (i.e. areas where movements are fundamentally constrained by canyons, steep cliffs, shorelines) for wildlife movement should be buffered and left in unmodified conditioned.

Mature or old growth forest cover should be maintained in a broad enough configuration so that riparian travel corridors do not become ecological traps and important hydroriparian ecosystems are not isolated from one another or upland areas.

One method of maintaining connectivity of forested ecosystems is to map and establish connected ecosystem reserves. Forest Ecosystem Networks (FENs), as described in the 1995 *Forest Practices Code Biodiversity Guidebook,* are one type of ecosystem network designed to yield benefits to ecosystem health.

Effective watershed level planning efforts could focus on resident species only or could take a broader more general approach. Note however that definitions of corridor habitats are species specific: Planned linkages for mountain goat will likely differ from those needed to maintain natural distributions of either pine marten or goshawk.

Connected ecosystem reserves can be designed to:

- reduce the impact of habitat fragmentation and rapid old-growth conversion,
- retain a representation of the full range of ecosystems,
- retain some forest habitat in interior condition,
- provide wildlife with areas of refuge during periods of disturbance on nearby sites, as well as acting as centers and corridors of dispersal for the recolonization of range,
- provide a continuum of relatively undisturbed habitat for indigenous species that depend on mature and old-growth forest, and
- provide daily and seasonal movement corridors for wide-ranging species.

2.2.2.3 Tailed frog

One of 6 North Coast amphibians, the blue-listed tailed frog, has a life history inextricably linked to fast flowing water and is found both in fish and non-fish ecosystems. It is a species that is sensitive to habitat change related to road building and forest harvesting. Landscape level changes are implicated in

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[22] pers. comm. D. Pearson, Ketchikan Alaska, US Department of Fish and Game. Comments made with reference to increased deer vulnerability to wolf predation as a function of landscape remnants: narrow riparian forested reserves lacking interior condition.

declines of tailed frog populations and in the listing of this species. In non-fish ecosystems this amphibian may be a keystone species and the top predator within the aquatic food chain.

Tailed frogs occur in a clustered distribution of isolated patches, which tend to be genetically distinct between creek systems. Dispersal capability is low with adults ranging only a few hundred meters from natal streams. Thus these amphibians are vulnerable: A minor development in the wrong place, could result in dramatic change to tailed frog habitat and result in local extirpation (elimination) and irreversible loss of genetic diversity. The situation is exacerbated by the fact that tailed frogs reside in non-fish streams, which may be harvested without retention of riparian forests. Furthermore non-fish streams may potentially be impacted by forestry activities that include in-stream works, cross-stream yarding and slash loading.

Management direction that safeguards stream habitat complexity, water flow and quality and prevents physical disturbance to non-fish streams will of course be of great benefit to tailed frog. Tailed frogs spend up to the first 4 years of life (eggs, hatchlings and tadpoles) within fast moving streams thus the survival of resident populations are by and large reliant upon suitable aquatic habitats. However to ensure full biological functionality, riparian buffers and landscape plans must be designed for purposes beyond the simple protection of the stream environment.

Better protection of adult tailed frog habitat might be achieved in aquatic and riparian areas deemed suitable for the species.[23] The occurrence and abundance of tailed frogs have been shown to be positively associated with both buffer width as well as the amount of old growth in a watershed.[24] A key determinant of adult habitat suitability is a developed understory within forest near natal streams. Tight canopies and dark second growth stands have less understory and less invertebrate food for adults resulting in low recruitment of adult breeders where streamside forests are less than 80 years of age.

Recent developments in tailed frog research have resulted in the identification of habitat associations such that a reliable methodology for suitability mapping is now available for the plan area. A recommended approach is outlined in *Watershed-level protection and management measures for the maintenance of Ascaphus truei populations in the Skeena Region" Ascaphus Consulting, March 2003.*

Note: The tailed frog is a sensitive and good indicator of hydroriparian habitat quality and thus the species may be amenable to adaptive management tools.

2.2.2.4 Bald eagle, heron and osprey nesting territories

The bald eagle, great blue heron and osprey are priority management species with needs for conservation measures.

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[23] Important stream and terrestrial characteristics of tailed frog habitat are outlined in *Watershed-level protection and management measures for the maintenance of Ascaphus truei populations in the Skeena Region" Ascaphus Consulting, March 2003.*

[24] *Watershed-level protection and management measures for the maintenance of Ascaphus truei populations in the Skeena Region" Ascaphus Consulting, March 2003.*

The bald eagle is a globally rare yet locally common blue-listed riparian species which is considered vulnerable and at risk of becoming threatened. "There are about 4,500 nesting pairs of bald eagles in BC. These represent about 50% of Canada's and 25% of the worlds nesting eagles. In winter BC is home for about 40% of the world's bald eagle population, including immature birds."[25]

The great blue heron is also a blue-listed riparian species which is similarly vulnerable and at risk of becoming threatened. It is a species of conservation concern because it's habitat is vulnerable to further disturbance. Coastal British Columbia populations, unlike herons in the interior of the province, are not migratory. Consequently coastal herons are isolated and are classified as a distinctive subspecies *Ardea herodias fannini.*[26]

The osprey is a fish eating raptor, which is a yellow-listed conservation species. It is so designated as it is associated with habitats (wetlands and riparian forests) and habitat elements (wildlife trees) that are rare or becoming rare. The osprey merits attention now to ensure that it does not slip into the "at risk" category.

Development can affect these species through habitat loss (direct and indirect) and disturbance. Alaskan studies have shown that nesting densities of bald eagles decline with increasing clearcut harvesting within 300m of nest sites.[27] Disturbance has been shown to cause eagles to abandon nest sites in the presence of human activity although some birds have shown significant tolerance.

There is considerable information pertaining to birds of prey (raptors) that show both a strong affinity for breeding in riparian habitats as well as a disproportionately high general use and dependency on some type of riparian habitat during part of their life cycle.[28] One of the best-studied raptors in the Pacific Northwest is the blue-listed bald eagle. Most bald eagles nest within 200m of water. In Washington, Grubb (1980)[29] found that the average distance of 218 nests from water was 86m, with 55 percent of these nests being within 46m. These birds typically nest in structurally variable forests (uneven-aged stands) and avoid even-aged stands that have a continuous, unbroken canopy. Science indicates that the abundance and distribution of birds of prey along riparian habitats in the Pacific Northwest are determined by prey availability and perch sites from which to forage, among other factors like human disturbance, and territoriality.

Bald eagles are associated primarily with aquatic habitats including marine shores, large lakes and large river shorelines. Most nest areas are likely to be found within 200m of these shorelines. Ospreys are most commonly associated with lakes and flooded reservoirs. Nests may be riparian but are also likely

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[25] *Bald Eagles and Forestry.* Pamphlet: BC Environment undated.

[26] Butler, Robert W. 1997. *The great blue heron. A natural history and ecology of a* seashore sentinel. UBCPress Vancouver.

27 Gende, Scott M., Mary F. Willson, Brian H. Marston, Mike Jacobson and Winston P. Smith. 1998. *Bald eagle nesting density and success in relation to distance from clearcut logging in Southeast Alaska.* Bio. Cons. Vol 83. No. 2. pp 121-126.

[28] Knight, R.L. 1988. *Relationships of birds of prey and riparian habitat in the Pacific Northwest: An overview.* In Streamside management: Riparian wildlife and forestry interactions. Ed. K.J. Raedeke. Univ. of Wash.

[29] Grubb, T.G. 1980. *An evaluation of bald eagle nesting in western Washington.* In R.L. Knight, G.T.Allen, M.V.Stalmaster, and C.W.Servheen (eds) Proceedings of the Washington Bald Eagle Symposium, p.133-144. The Nature Conservancy, Seattle.

to occur on dead trees standing within water. Few heron rookeries have been formally documented in the plan area but great blue heron are common to the area and are year-round residents, building platform nests and breeding in riparian areas.

The Wildlife Act (Section 35b) explicitly notes that the nest trees of bald eagles, ospreys and herons are protected. And it is an offence to injure or molest birds (Section 35a).

Within the North Coast Forest District frequent reports of development activities near nesting eagles lead to management recommendations specifically intended to mitigate disturbance to eagles. Recommendations relate to activity restrictions during sensitive periods (i.e. no blasting zones within 500m or development activities within 250m when nest sites are occupied) and recommendations to retain a minimum no-harvest 150m buffer around nest sites as well as to retain high-value wildlife trees along proximate riparian areas.[30]

Similar recommendations could be considered for both osprey and heron nest territories. These sites may also be impacted by development although nests are less frequently encountered and reported. Management issues related to osprey include harvesting of important riparian habitats as well as lake salvage operations which target standing wood in water (potential osprey nest trees) and disturbance as with eagles but also related to the rafting of log booms near osprey nest trees, especially those standing in water. Osprey are more sensitive to disturbance and have been known to fly at helicopters within close range of active nest territories.

Pre-development nest surveys in suitable habitats are advised to both protect nesting habitat and to avoid untimely operational costs and complications.

2.2.3 Coarse woody debris

Harvesting of old growth which is then followed by short rotation forestry (stands never ageing beyond 120 years) will over time drastically reduce or eliminate the larger pieces of coarse woody debris from managed stands. Such a consequence would result in harmful impacts to numerous species of conservation concern (i.e. fish, tailed frog, grizzly bear, northwestern salamander and spotted frog) and to the long-term productivity of forests themselves.

Downed wood is often a critical component within stream channels and on land. It functions in the channel by storing sediment and dissipating water energy. In fish streams and in riparian zones it often provides cover for fish, wildlife and other fauna. Dead wood is an important habitat suitability determinant for tailed frog, grizzly and black bear as well as numerous other aquatic and terrestrial species. Coarse woody debris also factors into forest health, particularly in wet ecosystems in which large pieces of wood function as nurse logs for regenerating trees. Dead wood is the subject of approximately 70 articles published in the recent *Proceedings of the Symposium on the Ecology and*

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[30] *Bald Eagles and Forestry – North Coast Forest District.* Ministry of Environment Lands and Parks, Habitat Protection Information Notice. June 1997.

Management of Dead Wood in Western Forests[31], which is recommended as a source of more detailed information.

Sustaining delivery of downed wood within aquatic systems requires assessment of the source and function of downed wood in the channel, upstream and downstream. The way a creek or river looks and behaves will depend largely upon the surrounding terrain and vegetation. High-energy streams on gradients too steep to maintain wood in the channel will transport it downstream. Downstream habitats may require ongoing wood delivery (i.e. a low gradient pool/riffle stream), or may not be substantially affected by a reduced delivery of wood (i.e. the ocean, steep boulder cascade stream). Some streams may be highly dependent on the presence of wood to minimize torrenting or maintain channel structure (i.e. some fluvial fans). Assessing the role of downed wood in the aquatic ecosystem will require an understanding of the source of downed wood, and it's transportation and deposition throughout the watershed. Consideration of dependency should be based on the stream's fullest geomorphologic maturity and not necessarily it's current development phase (i.e. a period of time following a landslide when the development of stream structure is not far advanced).

Note that mass failures can contribute organic materials to aquatic systems from distances of many hundreds of metres. Harvesting of naturally unstable terrain can to a large extent eliminate coarse woody debris inputs from the portion of the landbase that is harvested.

Channel bank stability is best maintained in those streams where buffers are provided– presuming buffers are naturally windfirm and remain substantially intact over time and that delivery of coarse woody debris, water quality and sediment continue within range of natural variability. An intact streamside forest and plant community is key in maintaining bank stability, especially on stream systems that are hydraulically active and/or dependent on downed wood to maintain channel function.

Maintaining bank stability depends on the processes in place and the structure of banks. Some streams are more susceptible to bank erosion, while others (i.e. bedrock controlled streams) are minimally susceptible. Streams with low potential to transport debris or sediment downstream will require less site-specific management than streams with high potential.

2.2.4 Non-fish streams

Non-fish streams are impacted by forestry activities that result in removal of riparian vegetation, in-stream works, cross-stream yarding and slash loading. Operational decisions regarding the treatment of "non-fish streams" are traditionally made in a risk management context that is focused upon the likelihood and consequence of failure (erosion or mass wasting events). Assessments of consequence are typically based upon best available information, and tend to centre on the protection of downstream fish values, placing much less emphasis upon the protection of the non-fish stream itself. Non-fish streams nonetheless are ecosystems unto themselves, some of which have inherently unique attributes. Due to a vast abundance of non-fish streams across much of the plan area, many of these systems fall outside of the timber harvesting landbase and thus are likely to remain unaffected by development.

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[31] *Proceedings of the Symposium on the Ecology and Management of Dead Wood in Western Forests*. November 2-4 1999. Pacific Southwest Research Station. USDA Forest Service General Technical Report PSW-GTR-181, August 2002.

Under current management practice, streams >=20% gradients are granted a default non-fish bearing status in the absence of information to the contrary. While fish do not commonly inhabitat streams of steeper gradient, fish biologists nevertheless have reported fish in coastal streams up to a 30% gradient[32], usually in stepped habitats or lake headed systems. At present there is no clear requirement to fully assess or inventory for either fish or non-fish values (i.e. amphibians, invertebrates or coarse woody debris dependency) of streams >=20% gradient, hence these ecosystems in the plan area remain poorly understood.

Yet some research has been undertaken and science has shown that coastal non-fish streams provide habitat for unique invertebrate species assemblages. Furthermore researchers have found a difference between invertebrate communities based upon whether or not they were associated with seasonal or continuous stream habitats. Some invertebrates were found only in seasonal streams.[33] Strategies to protect a broad representation of non-fish streams will aid in the conservation of biodiversity, tailed frog and coarse woody debris systems. Realistically however, the maintenance of riparian habitats for all streams would be impractical given the abundance and widespread distribution of small non-fish systems.

2.3 Maintaining the productive capacity of biodiversity hotspots

Added consideration and comment is provided with respect to specific habitats, which are noteworthy hydroriparian ecosystems in and of themselves. Biodiversity hotspots (areas of special or concentrated biodiversity value) that may merit added conservation emphasis within the plan area are discussed in the following order:

- Floodplains and fans
- Lakes
- Wetlands (including estuaries, swamp forests and sloped blanket bogs)
- Limestone and karst
- Geothermal springs
- Other "at risk" ecosystems
- Key hydroriparian areas of concern
    - o Lower Skeena and Ecstall riparian corridor
    - o Khtada and Union Lakes

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[32] pers. comm. Dionys De Leeuw, MELP biologist, Terrace, BC.

[33] Price, Karen, Arlene Suski, Joanna McGarvie, Barbara Beasley, and John S. Richardson. 2003. *Communities of aquatic insects of old-growth and clearcut coastal headwater streams of varying flow persistence.* Can. J. For. Res. 33:1-17.

2.3.1 Floodplains and fans

Floodplains and fans are typically priority conservation areas with very high fisheries and/or wildlife and biodiversity value. These are often a mix of "at risk" or red- and blue-listed plant communities. Off-channel and side-channel areas in particular provide important (sometimes critical) spawning, rearing, high-water refuge and overwintering habitats for fish. Floodplains can be areas of concentrated wildlife use and provide prime feeding, reproductive and corridor habitat for a variety of wildlife. Spatially floodplains and fans are rare in the plan area. A visual representation is provided on *Map 8. Floodplains, Lagoons, and Avalanches (south facing),* of the Special Elements map series produced for the LRMP table (March 2003).

Characteristically these types of hydroriparian ecosystems are moderately to highly productive sites that are attractive to forestry but sensitive to change. Development of these areas can be challenging:

- Deforestation can lead to unintended change with regards to water flow and channel structure and
- regeneration can be difficult.

The publication *A strategy for forest management and restoration on alluvial fans in the Prince Rupert Forest Region* provides a good outline of the issues and management opportunities with regards to fans in the plan area. "Alluvial fans are the moderately low-gradient (<20%) conical-shaped landscape features formed by the deposition sands, gravels, and cobbles when confined streams enter a large valley. They can be relic features of past erosion, or actively building. Fans are not initiation zones of mass wasting and the soils are generally too coarse to trigger surface erosion hazard schemes. Thus fans are not highlighted on our current forest hazard interpretive maps. Yet fans can pose significant environmental, forest management, and restoration challenges if care is not exercised..."[34]

Reserving and buffering all wet and dry floodplains and all active alluvial fans in full is a risk adverse approach to minimize impacts to these important ecosystems. Some exceptions might be made (i.e. road crossings or minimal road works where no other options exist, or to provide for human safety or activities prescribed for the management of fish or wildlife objectives) however in order to maintain a low risk outcome, any variance should be well supported with favourable assessments detailing both values present and how these sensitive ecosystems will be maintained.

Currently when considering development of alluvial fans, risk management strategies are applied that assess both risk of failure and consequence of failure to downslope or downstream values. In principal this makes good sense, however in practice, decision-making processes can fall short of ecosystem-based management goals if pre-existing information pertaining to downstream values is incomplete. Comprehensive assessments regarding downslope or downstream values (i.e. documentation of critical fish habitat and tailed frog habitat) could do much to enhance conservation efforts.

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[34] *A strategy for forest management and restoration on alluvial fans in the Prince Rupert Forest Region.* (1999. Dave Wilford, RPF, PGeo Research Forest Hydrologist).

2.3.2 Lakes

Lakes are considered rare or uncommon special elements[35] that collectively comprise approximately 48,000 hectares within the total plan area. Although on a provincial scale, coastal lakes are considered oligotrophic (deficient in plant nutrients and influenced by boggy acidic soils) these ecosystems frequently encompass microsites with high fish values and may also support high wildlife and biodiversity values in both aquatic and riparian communities.

There are in excess of 26,000 lakes within the plan area. The vast majority of these are small lakes that are less than 5 hectares (ha) in size. The remaining (1,087) include:

- 960 lakes which range between 5 and 60 ha,
- 84 ranging between 60 and 200 ha,
- 24 between 200 and 400 ha and
- 19 lakes greater than 400 ha in size.

A visual representation of this information (further subdivided into broad elevational bands) is provided on *Map 9. Lakes by elevation and size class.* of the Special Elements map series produced for the LRMP table (March 2003).

Hydroriparian lake ecosystems can be impacted by water diversions and hydro developments. Currently several small hydro energy sources are under consideration for development. Diana Lake, Brown Lake and Big Falls Lake are three places within the plan area that have already been dammed for water supply or hydroelectric generation. Environmental impacts associated with dams and the conversion of lakes into artificial reservoirs include the loss of functional lake littoral zones, the loss of fish passage, and the alienation of tributary fish streams which can become isolated from lake habitat. Repeated flooding and drawdown can essentially eliminate productive fisheries habitat along shores and can also precipitate bank erosion and gradual loss of adjacent riparian habitat. Enhanced riparian buffers on lake reservoirs could mitigate the incremental loss of riparian area that might be expected to occur over time. In a more favourable light, flooding of riparian forest has created suitable nesting habitat for osprey (i.e. Big Falls), a yellow listed raptor of conservation concern that nests in dead trees that are standing in water.

Activities related to forestry that can negatively impact lake ecosystems include the

- harvesting important sources of coarse woody debris and organic materials; i.e. riparian habitats, and naturally unstable slopes
- lake salvage operations which remove dead standing trees or floating or submerged logs (suitable osprey or fish habitat) from within lake ecosystems,
- creation of road access that either increases pressure on fish and game populations or causes excessive sedimentation,
- development of log handling areas within the hydroriparian ecosystem,

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[35] Special elements Map 9. *Lakes by elevation and size class.* Produced by the Government Technical Team for the NCLRMP March 2003

- use of lakes for log storage, log transport and helidrops that results in introductions of logging debris and shading of the littoral zone.

General management direction regarding lakes could be applied such that all lakes and their surroundings are treated equally. Note that at the present time, under the Forest practices Code, plan area lakes greater than 5 hectares in size are generically afforded a 10m (slope distance) riparian reserve zone (buffer of riparian vegetation). However not all lakes are equal. Some are more sensitive to disturbance than others and some clearly have higher biodiversity and socio-economic values than others (i.e. Khtada Lake, Union Lake).

Establishing management goals for a high number of lakes on an individual basis however would present quite a challenge to resource managers. In recognition of this, systematic approaches to the evaluation of lakes have been developed for other parts of BC which greatly aid in the identification of the higher value lake systems and the assignment of lake and lakeside management goals in accordance with values and societal interests.

One such protocol is outlined in the *draft Forest Practices Code Lake Classification and Lakeshore Management Guidebook: Vancouver Forest Region* [36]. Within this document management goals are determined on the basis of 3 general criteria: strategic objectives of higher level plans, existing or potential uses (public and commercial) and ecological significance. Four types of broad classifications result:

- **Wilderness Lakes** are managed to maintain natural features in pristine surroundings,
- **Quality Lakes** are managed to ensure a natural appearing environment,
- **General Lakes** may be in a rural or natural setting and are primarily maintained for public recreation,
- **Refugia Lakes** are areas with significant ecological importance and are managed to maintain natural ecosystem functions.

2.3.3 Wetlands (including estuaries, swamp forests and sloped blanket bogs)

Special Elements map series *Map 7: Estuaries and wetlands*[37] indicates the location of rare and productive wetland sites within the plan area that are mappable at a strategic planning scale (1:250,000). These are primarily non-forested wetlands that are attractive to many wildlife and may also sustain significant fisheries value. Some of the wetlands mapped are especially noteworthy for large size such as the provincially significant wetland/estuary complex of the Kitsault, Dak and Illiance Rivers at the head of Alice Arm. Smaller wetlands and coastal bogs that are more common and widespread are not illustrated.

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[36] *FPC Lake Classification and Lakeshore Management Guidebook: Vancouver Forest Region*. Draft October 2000.

[37] Special elements Map 7. *Estuaries and wetlands*. Produced by the Government Technical Team for the NCLRMP March 2003

Plan area wetlands can be impacted by development activities (adjacent roads and harvesting) that redirect or otherwise affect water movement or that alter fringe forests thus degrading important wildlife habitats; generally the combination of wetlands and adjacent forests. Adjacent riparian forest buffers commonly function as important breeding habitat, foraging habitat and security cover for numerous species (microtines, birds to large mammals) attracted to wetlands. Research indicates that as buffer widths of riparian community increase so does hydroriparian habitat effectiveness. Conversely, as riparian buffers are decreased by development, riparian communities begin to function as ecological traps. Wildlife may still breed in or otherwise be drawn to riparian habitats but survival of eggs, young or adults of many species may be drastically diminished.

Wetland fringe forests that support lush skunk cabbage growth are attractive foraging areas to large mammals like grizzly, black bear, moose and deer. Intact riparian fringes along wetlands also provide important habitat to semi-aquatic species like salamanders that breed in water and do not move far from breeding sites. The most commonly observed amphibians are the rough-skinned newt, the northwestern salamander and the western toad that require slow moving or still water for breeding.

Estuaries are particularly rare ecosystems that have very high fish and wildlife value. These are usually herb-dominated tidal wetlands, occurring where seawater is diluted with fresh. Herbaceous growth provides critical forage for bears just emerging from a long period of fasting and hibernation. Riparian forests adjacent to estuaries tend to be favoured by nesting eagles and other fish eating birds lured by an abundance of food. Estuaries are also attractive to deer and moose and numerous other species as foraging and resting habitat. Estuaries provide staging habitat for migrating waterfowl and brackish water conditions that are important rearing habitats for juvenile fish.

Forestry developments in this plan area frequently involve road networks that begin close to estuaries. The maintenance of adequate security cover around estuarine habitats is a determinant of habitat suitability for large game as well as other species and thus should also be a management goal if intact ecosystems are to be maintained.

Swamp forests are rare and especially sensitive forested wetlands, which occur on floodplains but also at the toe of a slope or on other seepage sites. Swamp forests are moderately productive stands dominated by western red cedar and Sitka spruce (CWHvh2 site series 13). These forests are also noted for lush skunk cabbage patches, which may be critical spring feeding areas for grizzly (blue-listed) and black bear. Swamp forests should not be harvested. Apart from high wildlife value and potential fisheries value, harvesting of these sites could cause the water table to rise (Dubé et al. 1995)[38],thus decreasing available water storage capacity, increasing peak water flows, and potentially increasing the risk of flooding (Fitzgerald et al. in press).[39] Swamp forests are very difficult if not impossible to regenerate to the original stand profile.

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[38] Dubé, S. and A.P. Plamondon. 1995. Relative importance of interception and transpiration changes causing watering-up after clearcutting on four wet sites. *In* Man's Influence of Freshwater Ecosystems and Water Use (*Proceedings of a Boulder Symposium, July 1995*), pp 113-120.

[39] Fitzgerald, D.F., J.S. Price and J.J. Gibson. In press. Hillslope-swamp interactions and flow pathways in a hypermaritime rainforest, British Columbia. *Hydrol. Process.*

Sloped hypermaritime bogs in this plan area are found within the Hecate Lowlands ecosection. These are unique to the Northern Hemisphere, occurring only on coastal British Columbia, Southeast Alaska, the Western British Isles and Norway. Similar to the Bald eagle, these are elements of biodiversity that are globally significant and rare but locally common. Sloped blanket bogs can be complexed with other wetlands and bog forest. Those reaching from sea level to the alpine can have exceptionally diverse flora.[40] These are areas of relatively low productivity and there are no current development interests that directly threaten these wetlands.

2.3.4 Limestone and karst

Limestone occurrences on the coastal mainland and islands are rare and localized (i.e. Porcher, Kumealon and Aristazabel). When forested, stands on limestone often show increased productivity. High volume stands are very attractive to forestry and consequently forested limestone areas within coastal ecosystems have been disproportionately harvested.

Limestone is prone to erosion, and sensitive to change. Once deforested there can be a greater loss of soil and an increase in bare rock as compared to volcanic bedrock types.[41] Recovery can take many centuries. Mapped limestone polygons[42] as depicted on Special Elements Map 6 *Geology: Hotsprings, limestone and karst*[43]. occurring within hydroriparian ecosystems should be managed carefully and treated as rare habitats.

Furthermore, areas identified as having karst potential should be assessed by qualified professionals for relative biodiversity value and vulnerability to harvesting prior to development planning. In areas with karst features, surface runoff is rapidly incorporated into underground drainage systems. Slash, silt and debris that may be washed into subsurface drainage networks can adversely affect cave systems. Vulnerability mapping (Baichtal et al. 1995)[44] recognizes that some parts of a karst landscape are more sensitive than others to planned land uses. Assessments and strategies that ensure that karst resources are not negatively impacted would benefit conservation efforts to protect these unique habitats.

Karst is a distinctive topography in which the landscape is largely shaped by the dissolving action of water on carbonate bedrock (usually limestone, dolomite, or marble). This geological process, occurring over many thousands of years, results in unusual surface and subsurface features ranging from sinkholes, vertical shafts, disappearing streams, and springs, to complex underground drainage systems and caves. Karst stream systems can play a significant role in the productivity of downstream aquatic habitat. Karst can increase fish productivity in the following ways:

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[40] pers. comm. J. Pojar. Research Ecologist, MoF Prince Rupert Forest Region.

[41] Harding, K.A. and D.C. Ford. 1992. *Impacts of primary deforestation upon limestone slopes in northern Vancouver Island, British Columbia.*

[42] Karst Potential Mapping for the Prince Rupert Forest Region. 1995. Terra Firma Geological Services. Namaimo BC.

[43] Special Elements Map 6 *Geology: Hotsprings, limestone and karst.* Produced by the Government Technical Team for the NCLRMP March 2003.

[44] Baichtal, James F., Douglas N. Swantston and Anne F. Archie. 1995. *An ecologically-based approach to karst and cave resource management* In *Proceedings of the 1995 National Cave Management Symposium*, October 25-28, 1995. Ed. G.T. Rea. Produced by the Indiana Karst Conservancy.

- the leaching of calcium carbonate from bedrock has important buffering effects on acidic streams,
- the groundwater associated with karst results in cool, even stream temperatures throughout the year,
- the storage capacity in karst stream systems buffers seasonal flow rates to produce lower peak flows and higher low flow periods,
- limestone promotes nutrient uptake and encourages more algae and moss growth,
- aquatic insect populations within karst streams are larger and more diverse,
- karst stream systems may provide more protective sites for fish to rest, breed, and avoid predators.

2.3.5 Geothermal springs

Geothermal hotsprings in this area are poorly studied and incompletely understood. They are ecologically important because they are biologically rare and unique special elements. The occurrence and distribution of known areas is shown on Special Elements Map 6, *Geology: Hotsprings, limestone and karst*[45].

Hotsprings are often vulnerable because they are subject to high levels of recreational use and development. Bishop Bay Hotsprings is a Ministry of Forests recreation site that probably receives the most use of hotsprings in this area despite the fact that access is limited to boat and air.

More detailed information on sites can be found in *Study of the potential use of geothermal springs for fish culture in the Pacific drainage of British Columbia*[46] and *Hotsprings of Western Canada.*[47]

2.3.6 Other "at risk" ecosystems

High and very high risk ecosystems as defined by the Coarse Filter Biodiversity Environmental Risk Assessment[48] and red and blue-listed ecosystems as defined by the Conservation Data Centre (CDC), are all considered "at risk" ecosystems and habitats of conservation concern. Those that occur within hydroriparian ecosystems of the North Coast plan area should be treated as rare and vulnerable habitats. Efforts to conserve these places where they occur (whether complexed with other ecosystems or not) would benefit general measures to achieve an ecosystem-based management plan.

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[45] Special Elements Map 6 *Geology: Hotsprings, limestone and karst.* Produced by the Government Technical Team for the NCLRMP March 2003.

[46] Goodbrand, D.W. and J.T. Crandall. 1977. *Study of the potential use of geothermal springs for fish culture in the Pacific drainage of British Columbia.* Prepared for DFO, Vancouver BC. DSS contract No. OSS77-08096.

[47] Woodsworth, Glenn. *Hotsprings of Western Canada.* and a second reference by the same title McDonald, Jim. 1991. *Hotsprings of Western Canada.*

[48] Holt, Rachel F. and Glenn Sutherland. 2003. *Coarse Filter Biodiversity. Environmental Risk Assessment: Base Case.* NCLRMP document.

2.3.7 Key hydroriparian areas of concern

2.3.7.1 Skeena/Ecstall Area

Typically larger stream systems tend to have not only greater economic value but also greater ecological significance. I.e. The Skeena River, obviously attractive as a development corridor, is also a provincially and regionally significant ecological link between interior and coastal ecosystems. This connection involves an ongoing exchange of outputs (i.e. fresh water, nutrients, sediment, trees with anchoring root wads, and juvenile fish) for returns of marine nutrients via inbound anadromous species (i.e. adult salmon, eulachon, steelhead, sea runs of Dolly Varden and cutthroat trout).

The lower Skeena and the Ecstall River floodplains are a matrix of red and blue-listed plant communities. Part of the high biodiversity value stems from the deciduous components of the riparian habitat.

Because these systems are large, development opportunities within appear to be more conducive to flexibility. Nevertheless the same principles of maintaining ecosystem connectivity, a proportion of representative habitats in old growth condition etc. apply.

Sections of these rivers in the plan area provide critical habitat for fish (spawning and incubation habitat for eulachon and intertidal estuarine areas used by juvenile salmonids).

Current development in the area includes Highway 16 and the CN Rail line which both intrude upon the Skeena River, a forestry road between Scotia and Ayton Creeks which also intrudes upon the Skeena River (note, both road developments were required to implement substantial fisheries compensation projects), a log dump at Scotia Creek, and hydroelectric projects at Big Falls Creek and Brown Lake (tributaries to the Ecstall) and associated powerline right of ways. There is a high likelihood of further development (i.e. mining and forestry) that may require more roads and log dumps that could degrade the quality of fish and wildlife habitat.

2.3.7.2 Khtada and Union Lakes

Khtada and Union Lakes support the largest sized trout in the plan area and as such are relatively unique. Our understanding of how these ecosystems have developed to support such large fish is poor. Nevertheless they provide excellent recreational fishing opportunities as well as areas of scientific study. Khtada Lake also supports an estimated resident population of 373,000 lakeshore spawning kokanee salmon. Development activities that may alter the natural appearance and functioning of the aquatic ecosystem have the potential to compromise fisheries and socio-economic values.

3 Definitions

Active Floodplain: Areas adjacent to a stream channel that are flooded frequently.

> **Dry Floodplain:** Floodplain that is higher than wet floodplains, flooded infrequently (approximately once in 6 to once in 30 years), and does not exhibit wetland vegetation types (unless flooded from the valley side). Within the Biogeoclimatic ecosystem classification (BEC), "high fluvial bench" corresponds to dry floodplain.
>
> **Wet Floodplain:** Area adjacent to a stream channel that is flooded more frequently than once in 5 years and commonly exhibits wetland vegetation. Wet floodplains include old, filled channels and low floodplain surfaces. They form part or all of the *active floodplain*. Within the BEC, wet floodplains correspond to "low and middle fluvial benches".

Anadromous: going upstream to spawn, usually from salt to fresh water.

Blue-listed: A blue-listed species or plant community is considered vulnerable and at risk of becoming threatened in BC. The blue-list is maintained by the Conservation Data Centre that operates within BC.

Critical fish habitat: Important fish habitats are considered critical if change to these places has a potential to either diminish or eliminate a fish stock.

High-value wildlife tree: A high-value wildlife tree[49] has at least two characteristics listed below:

- Internal decay (heart rot or natural/excavated cavities present)
- Crevices present (loose bark or cracks suitable for bats)
- Large brooms present
- Active or recent wildlife use
- Current insect infestation
- Tree structure suitable for wildlife use (e.g., large nest, hunting perch, bear den, etc.)
- Largest trees on site (height and/or diameter) and/or veterans
- Locally important wildlife tree species.

Hydroriparian: The combination of aquatic and riparian ecosystems that are influenced by one another.

Karst: unique and rare landforms associated with soluble rock characterized by underground drainage, caves and sinkholes

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[49] *Evaluation of Wildlife Tree Retention for cutblocks harvested between 1996-2001 under the Forest Practices Code*. For. BC. Min. For. B.C. Min. Wat. Land Air Pro. Victoria, B.C. 2003.

Keystone species: a species that plays an important ecological role in determining the overall structure and dynamic relationships within a biotic community. A keystone species presence is essential to the ecosystem.

Important Fish Habitat: Freshwater or marine habitats that significantly influence the abundance and survival of a particular stock or population of fish include the following areas of importance:

- productive spawning beds for salmonids, eulachon, or other fish,
- productive rearing habitat, overwintering habitat and high-water refuge areas.

Mitigation: A method used to lessen or minimize impact.

Precautionary Approach: (from the HPG) A precautionary approach entails adopting management procedures that are unlikely to pose significant risk to ecosystem viability, even though thresholds for substantial change are not known. Precautionary management guidelines are conservative management recommendations based on forest management experience to date.

Qualified Professional: A person trained and experienced in the specific area of assessment and ecosystem setting. I.e. wildlife/danger trees, geotechnical survey, critical fish habitat inventory, karst vulnerability assessments, windthrow, ungulate winter range. Note that professional discretion does not necessarily provide a due diligence defence.

Red-listed: A red-listed species or plant community is considered endangered or threatened in BC. The red-list is maintained by the Conservation Data Centre that operates within BC.

Tree height: site specific tree height derived from the tallest trees present, if the stand is not mature then an approximation derived from the site capability (forest cover inventory) should be used.

Windfirm forested buffer: Trees retained are not rendered more susceptible to overturning under endemic conditions (normal conditions which include gale force winds that have a recurrence interval of 5-10 years but do not include catastrophic winds – major storm events) due to the removal of adjacent forest cover. Windfirmness is a function of both tree crown and rooting characteristics.

Yellow-listed conservation species: A yellow listed species that is of management concern for reasons of conservation need. It includes a) species which are apparently secure but which may have a restricted distribution; or there may be perceived threats or b) species that are associated with a habitat or habitat element that is rare or becoming rare. These species merit observation so that they are prevented from entering the "at risk" category. These species are not considered to currently be at risk (neither red nor blue listed by the Conservation Data Centre). This list is independently maintained by the Wildlife Branch and thus excludes fish and marine mammals. There are 5 sublists of the yellow list: 1) species maintained through ecosystem management, 2) conservation species, 3) species managed for hunting, trapping or falconry, 4) species of global responsibility, and 5) non-native species.